DOCUMENT RESUME

ED 103 261 SE 018 640

TITLE	Troubleshooting, Section Two, Boilers: Flame Reading. Part 4, Air Pollution Training Institute Self-Instructional Course SI-466.
INSTITUTION	Environmental Protection Agency, Research Triangle Park, N.C. Air Pollution Training Inst.; Sage (David) Inc., New York, N.Y.
PUB DATE	[73]
NOTE	36p.; Related documents are SE 018 637-643
EDRS PRICE	MF-$0.76 HC-$1.95 PLUS POSTAGE
DESCRIPTORS	*Air Pollution Control; *Autoinstructional Aids; *Environmental Education; Environmental Technicians; *Independent Study; *Pollution; Post Secondary Education; Programed Instruction; Programed Materials
IDENTIFIERS	*Boilers; Flame Reading

ABSTRACT

This workbook is part four of a self-instructional course prepared for the United States Environmental Protection Agency. The student proceeds at his own pace and when questions are asked, after answering, he either turns to the next page to check his response or refers to the previously covered material. The purpose of this course is to prepare the student for his APC Training Certificate. This section is concerned with analyzing the flame, which may be the key to solving many boiler problems. This book gives the student tasks to do for some common, incorrect flames. (BT)

ED103261

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
NATIONAL INSTITUTE OF EDUCATION
THIS DOCUMENT HAS BEEN REPRODUCED EXACTLY AS RECEIVED FROM THE PERSON OR ORGANIZATION ORIGINATING IT. POINTS OF VIEW OR OPINIONS STATED DO NOT NECESSARILY REPRESENT OFFICIAL NATIONAL INSTITUTE OF EDUCATION POSITION OR POLICY

BEST COPY AVAILABLE

Air Pollution Training Institute
Self-Instructional Course SI-466

Part 4
Troubleshooting, Section Two
Boilers: Flame Reading

CE 018 640

United States
Environmental Protection Agency
Contract No. 68-02-0321
David Sage, Inc.
New York City, New York

Part Four:
Troubleshooting
Section Two
Boilers: Flame Reading

David Sage, Project Manager, DSI
Mariland Ruppart, Writer Analyst, DSI
C. George Segeler, P. E., Staff Engineer, DSI
and
William Todd, Project Officer, USEPA

Prepared for the
United States Environmental Protection Agency
Office of Air and Water Programs
Control Programs Development Division
Air Pollution Training Institute

4

THIS IS PART 4
TROUBLESHOOTING, SECTION TWO
BOILERS: FLAME READING

Additional units of this self-instructional course are:

PART ONE
The Basics of Preventing Air
Pollution Emissions from Boilers

PART TWO
The Basics of Boiler Operation
and Maintenance

PART THREE
Troubleshooting, Section One
Boilers: Correcting Oil Temperature

PART FIVE
The Incinerator: Section One
Basic Parts and Fundamentals

PART SIX
The Incinerator: Section Two
Maintenance and Troubleshooting

SUPPLEMENT A:
Operator's Manual, Boiler Room
Operations and Maintenance

TROUBLESHOOTING
FLAME READING

When the smoke alarm goes off, oil temperature is the first thing to check.

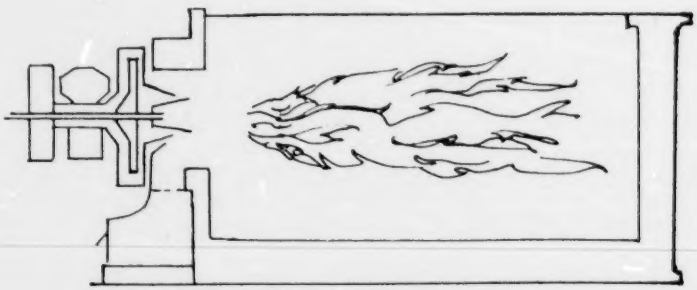
If the oil temperature is OK, THE FLAME may be the key to solving the problem.

This book will give you simple tasks to do for some common incorrect flames. The corrections here assume that the oil flow is normal. Troubleshooting is complicated due to the delicate nature of the air/oil ratio. If the problem is not easily solved, call service and report what you have found.

FLAME AWAY FROM THE BURNER

Most boilers have a peephole. Through it you can see the flame.

Look at this flame.



CIRCLE THE CORRECT ANSWER:

This flame is: A. too close to the burner.
B. too far away from the burner.

The most likely reason is that the flame above is being pushed off the burner by TOO MUCH PRIMARY AIR.

The PRIMARY AIR SHUTTER (regulated by LINKAGE) is taking in too much air. If you know how to set the Primary Air Shutter, adjust it carefully. The correct air/oil ratio is the key to good flames and smokeless burning. If you don't know a lot about it, call service.

Check the parts below which may need adjustment to correct a flame off the burner:

_____ Primary Air Shutter
_____ Primary Air Linkage
_____ Secondary Air Damper

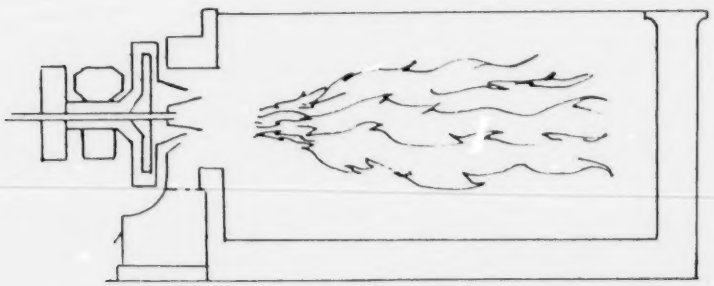
– Check your answers

_____ Primary Air Shutter

_____ Primary Air Linkage

_____ Secondary Air Damper

LOOK AT THIS FLAME.



1. How does this flame not look right? _____

2. What should you suspect when you get a flame like this? _____

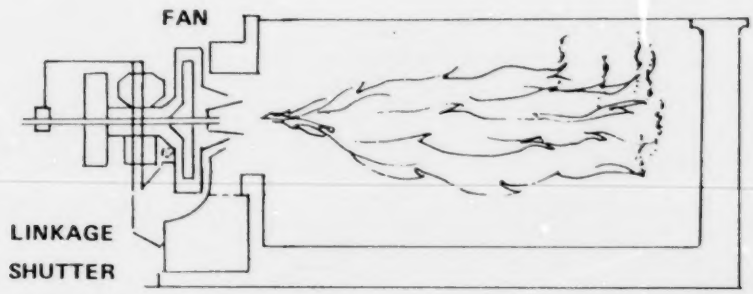
– Check your answers.

1. too far away from burner
2. too much primary air

SMOKY FLAME

A Smoky Flame (unstable and flickering) means NOT ENOUGH AIR. Check the three parts of the primary air system.

PRIMARY AIR



The PRIMARY AIR SHUTTER and LINKAGE can be lubricated and cleaned but change the setting only if you have been taught to do it accurately on your system.

You know how your FAN should sound. Blades may need to be cleaned; belts may need to be tightened.

CIRCLE THE PARTS ON THE DIAGRAM THAT YOU CAN KEEP CLEAN AND IN GOOD WORKING ORDER.

Answer these questions:

1. Do smoky flames come from too much or too little air? _____

2. When you get a smoky flame, first check the _____ air.

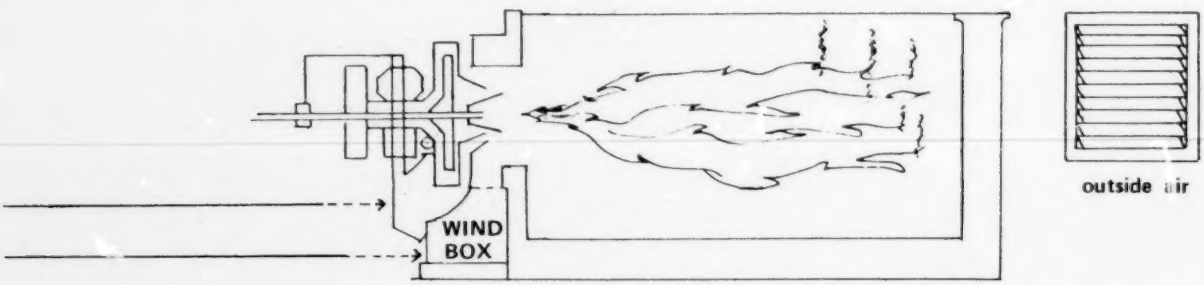
— Check your answers.

1. too little
2. primary

If the Primary Air is all right, check –

SECONDARY AIR

The Windbox may not be delivering enough air. LABEL THE LINKAGE and DAMPER on the lines in the diagram.



Linkage must be set properly and lubricated to move easily. It should clear the floor when in the lowest position.

The damper should be clean.

1. If you get a smoky flame, what do you check after the primary air? _____

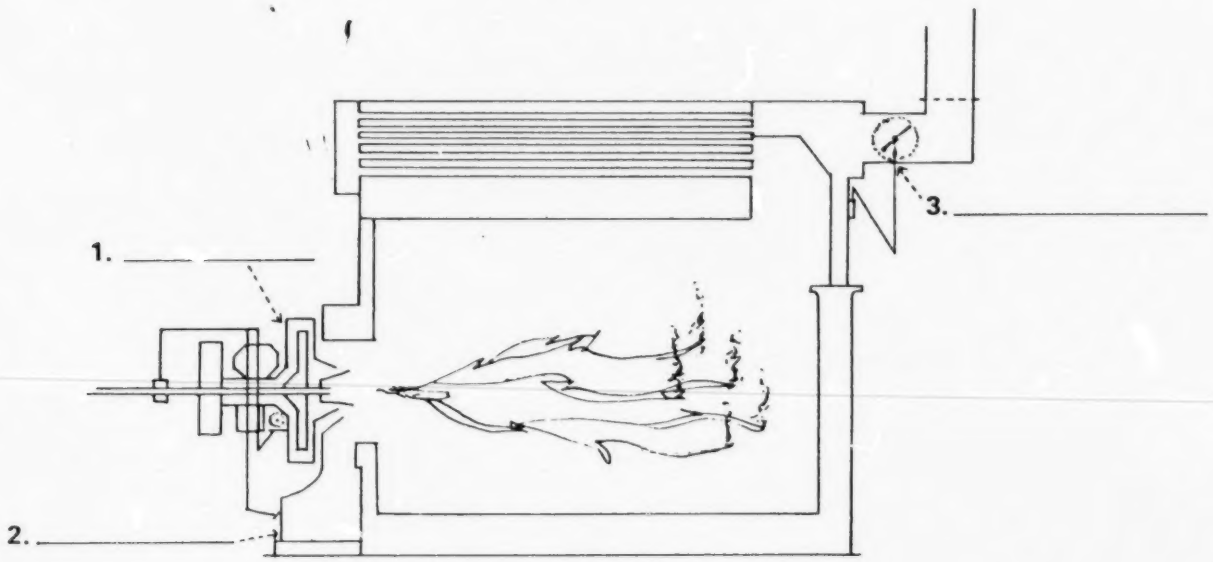
2. What equipment must be set and move easily to deliver secondary air? _____

_____

– Check your answers.

1. Secondary Air
2. Linkage, Damper

SMOKY FLAME - NOT ENOUGH AIR



On the diagram, LABEL THREE SOURCES OF AIR to check when you get a Smoky Flame –

PRIMARY AIR
SECONDARY AIR
STACK DAMPER

The STACK DAMPER should move freely and not be blocked. You may or may not adjust this damper, but you can keep it lubricated and clean.

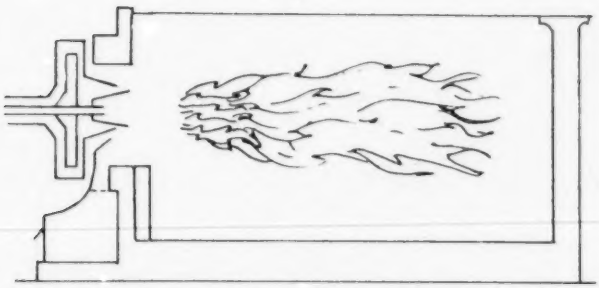
1. Is your stack damper manual or automatic? _____

2. What can you do to keep the stack damper in good condition? _____

– Check your answers.

1. Check your own answer
2. clean it, lubricate it

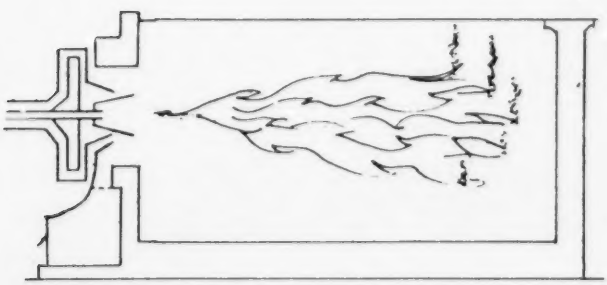
Here are two incorrect flames.
CIRCLE the correct answers beside each diagram.



This flame is: AWAY FROM THE BURNER
SMOKY

A cause is: TOO MUCH AIR
NOT ENOUGH AIR

Troubleshoo ting
Checks: PRIMARY AIR
SECONDARY AIR
STACK DAMPER



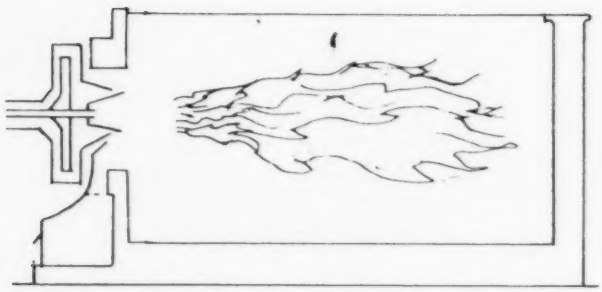
This flame is: AWAY FROM THE BURNER
SMOKY

A cause is: TOO MUCH AIR
NOT ENOUGH AIR

Troubleshooting
Checks: PRIMARY AIR
SECONDARY AIR
STACK DAMPER

— Check your answers.

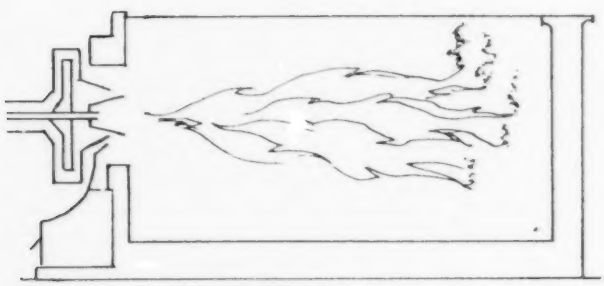
ANSWERS TO PREVIOUS PAGE.



This flame is: AWAY FROM THE BURNER

A cause is: TOO MUCH AIR

Troubleshooting
Checks: PRIMARY AIR



This flame is: SMOKY

A cause is: NOT ENOUGH AIR

Troubleshooting
Checks: PRIMARY AIR
SECONDARY AIR
STACK DAMPER

HANDBOOK SUMMARY

TURN IN YOUR BOILER HANDBOOK TO PAGE 46.
Here is an incorrect flame summary for your future reference.

NOW, LOOK AT PAGE 47 in the HANDBOOK.

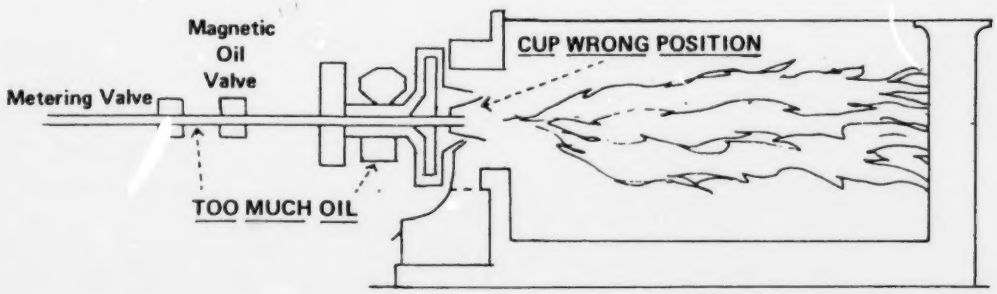
Here is your own table of incorrect oil flames. Under each flame is space to write a probable cause of the flame, and some Troubleshooting Checks.

WRITE IN A CAUSE AND TROUBLESHOOTING CHECKS UNDER "FLAME AWAY FROM THE BURNER" AND "SMOKY FLAME." Use Page 14 in this book for reference.

After completing this work, go on to the next page.

FLAME TOO LONG

HITS THE WALL – SMOKY TIPS



If there is TOO MUCH OIL going into the burner, there will be too much flame (too long) in the firebox.

Your upgraded system should have the OIL VALVES shown above. The Metering Valve is set by the oil representative; you should change it only if you have been trained on your system.

ANSWER THESE QUESTIONS:

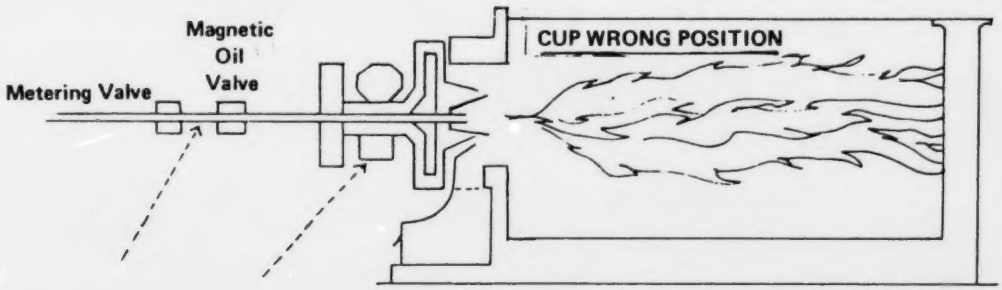
1. Too much oil may give you what kind of flame? _____

2. On the diagram, two _____ regulate the oil flow.

-- Check your answers.

1. too long
2. valves

WRITE ONE CAUSE OF A LONG FLAME on the line in the diagram:



_____

Check your answer on the preceding page.

If the CUP is set OUT FROM THE BURNER too far, it will extend the flame and cause it to hit the wall. REPLACE THE CUP CORRECTLY EACH TIME YOU CLEAN IT.

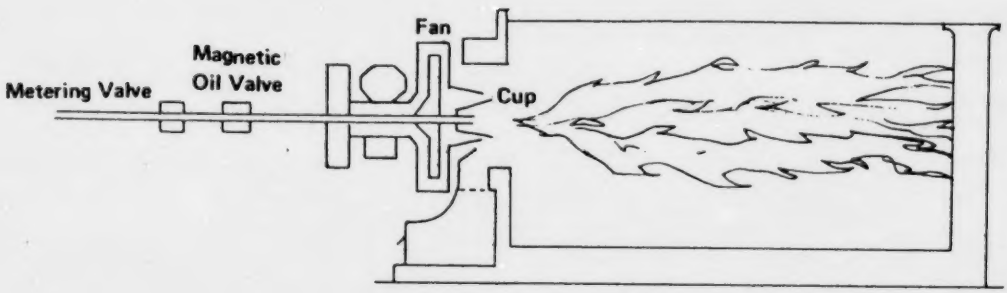
ANSWER THESE QUESTIONS:

1. In addition to oil valves what device shown on the diagram must be set correctly for a good flame? _____

2. Are you responsible for correct cup position? _____

— Check your answers.

1. cup
2. yes



When your smoke alarm goes off, you may see a flame like the one above in your firebox.

1. What is wrong with the flame above? _____

2. What are two causes of this incorrect flame? _____

_____

3. What instruments may be adjusted to correct it? _____

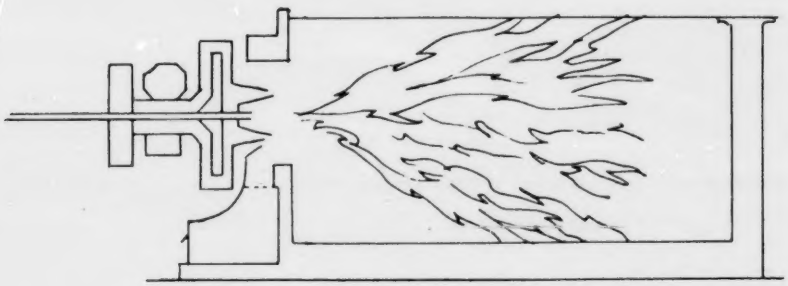
_____

— Check your answers.

1. too long
2. too much oil, wrong cup position
3. oil valves, cup

ANOTHER BAD FLAME

CIRCLE THE CORRECT WORD under the diagram:



Flame is too
NARROW/WIDE

The flame may become too wide like the one above if the AIR CONE AROUND THE CUP is NOT STRONG ENOUGH. Or, the CUP could be in the WRONG POSITION.

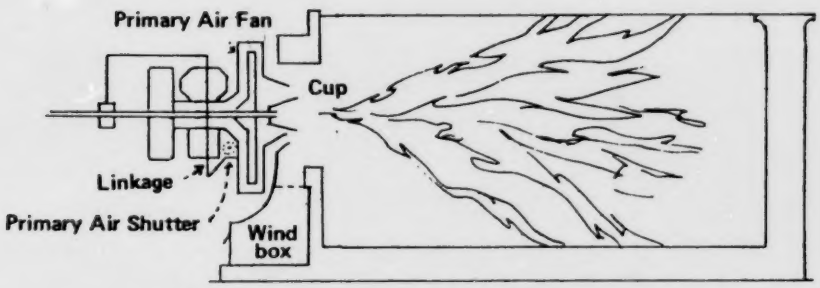
ANSWER THESE QUESTIONS:

1. You may get a wide flame if there is not enough:
   A. PRIMARY AIR
   B. SECONDARY AIR _____

2. What must be in the proper position to atomize a good flame? _____

— Check your answers.

1. A. Primary Air
2. cup



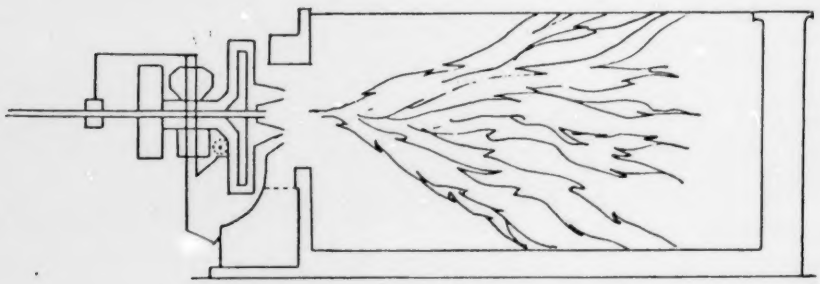
Two causes of a WIDE FLAME have been considered.

1. What equipment would you check to troubleshoot TOO LITTLE PRIMARY AIR? (see diagram) _____

2. If the Primary Air is OK, what other equipment would you check to troubleshoot a wide flame? _____

— Check your answers.

1. Primary Air Shutter
   Linkage
   Primary Air Fan
2. cup



When your smoke alarm goes off you may see a flame like the one above.

1. How is the flame above incorrect? _____

2. What are two common causes of this type of flame? _____

   _____

3. What equipment would you check to correct it? _____

   _____

— Check your answers.

1. too wide
2. not enough Primary Air
   cup in wrong position
3. Primary Air Shutter, Linkage, Fan, Cup

Below are two incorrect flames.
CIRCLE the correct answers beside each diagram.

This flame is: TOO LONG
TOO WIDE

Some causes are: TOO MUCH OIL
TOO LITTLE PRIMARY AIR
CUP IN WRONG POSITION

Troubleshooting Checks: PRIMARY AIR
OIL VALVES
CUP

This flame is: TOO LONG
TOO WIDE

Some causes are: TOO MUCH OIL
TOO LITTLE PRIMARY AIR
CUP IN WRONG POSITION

Troubleshooting Checks: PRIMARY AIR
OIL VALVES
CUP

— Check your answers.

ANSWERS TO PREVIOUS PAGE:

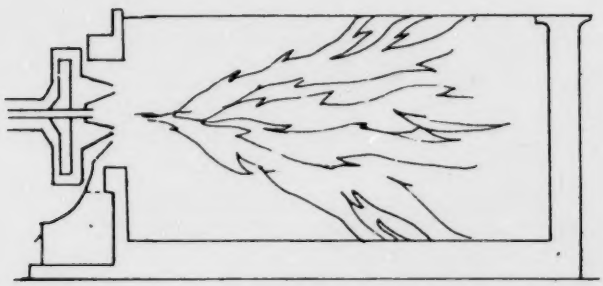
This flame is: TOO LONG

Some causes are: TOO MUCH OIL

CUP IN WRONG POSITION

Troubleshooting Checks: OIL VALVES

CUP



This flame is: TOO WIDE

Some causes are: TOO LITTLE PRIMARY AIR

CUP IN WRONG POSITION

Troubleshooting Checks: PRIMARY AIR

CUP

HANDBOOK SUMMARY

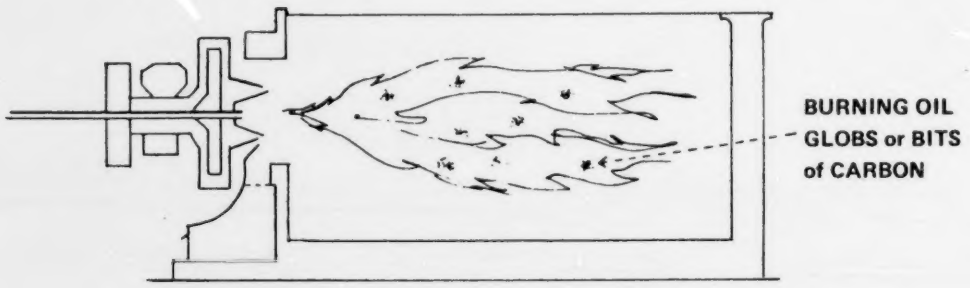
TURN TO YOUR BOILER HANDBOOK, PAGE 47.

COMPLETE INCORRECT FLAME COLUMNS 3 and 4 with the information you have just learned.

Use page 30 in this book for reference.

"SPARKY" FLAME

Here are small areas where too much oil is burning and bits of burning carbon can be seen. They do not look like electric sparks but are spots where extra oil or carbon is burning.



When this happens the CUP may be either DIRTY, DAMAGED, or in the INCORRECT POSITION. If cleaning and adjusting the cup doesn't help, call service.

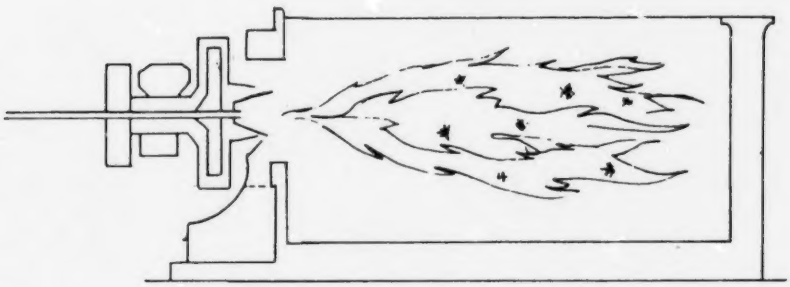
1. "Sparks" in the flame could be bits of burning _____ or _____

2. What can you do to try to correct a "sparky" flame? _____

_____

— Check your answers.

1. oil or carbon
2. clean and adjust the cup



1. Why is the flame above not a good flame? _____

2. What could be causing this flame? _____

3. What do you check to troubleshoot this flame? _____

— Check your answers.

1. has "sparks" in it
2. *oil globs or carbon*
3. cup (clean or adjust)

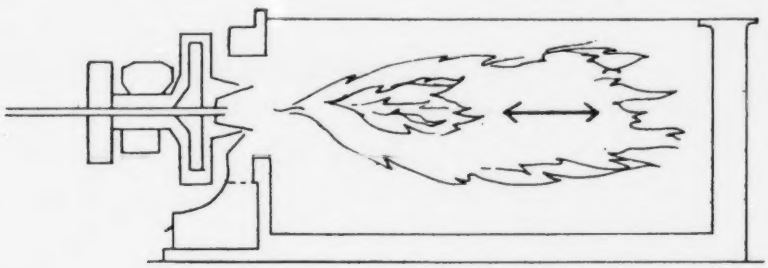
PULSATING FLAME

A pulsating flame is one that changes in rhythm - large, small, large, small, etc. It is likely to be noisy.

Three possible causes you may be able to correct:

WRONG AMOUNT OF OIL
UNEVEN OIL FLOW
NOT ENOUGH AIR

CIRCLE the correct words under the picture.



To troubleshoot this flame, check the
AIR/OIL/CUP

As there are many causes of a pulsating flame, it is difficult to troubleshoot. If the air and oil checks you will learn don't stop pulsation, call service.

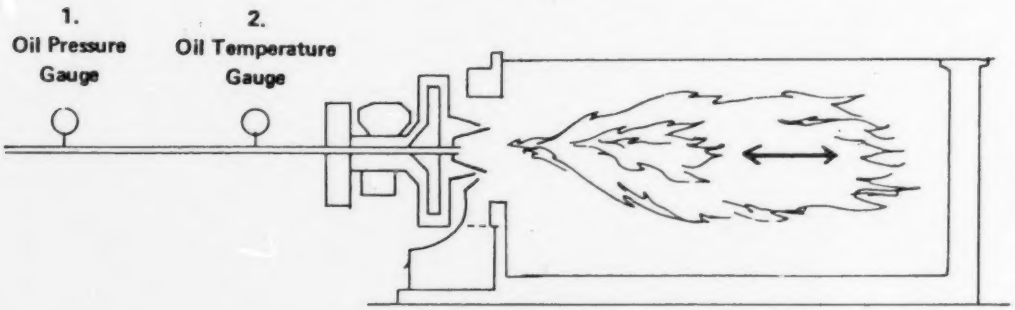
What are two oil problems which may cause a pulsating flame? _____

_____

— Check your answers.

wrong amount of oil
uneven oil flow

Two checks concerning oil:



What should the oil temperature closest to the burner be on your system? _____

What should your oil pressure gauge read? _____

You have this information in your Handbook. Checking OIL TEMPERATURE and troubleshooting OIL HEATERS was covered in the last section.

OIL PRESSURE checks will be taken up on the next page.

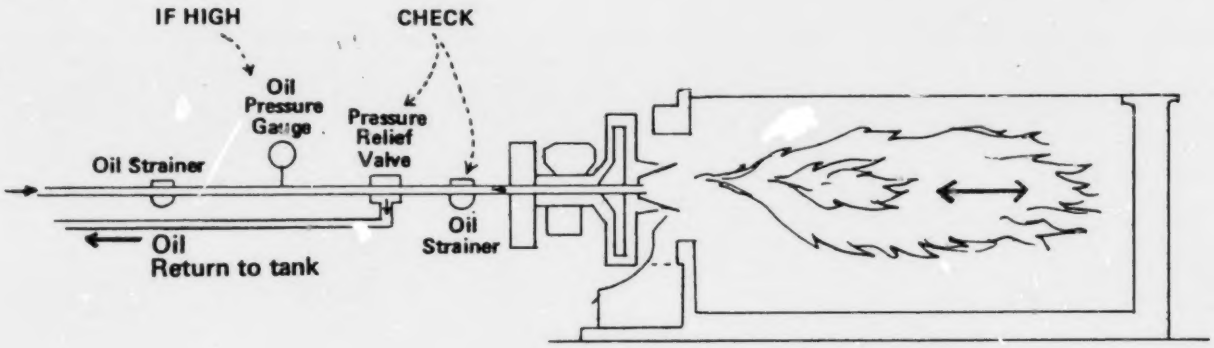
1. What is wrong with the flame above? _____

2. What two oil gauges do you check in troubleshooting it? _____

— Check your answers.

1. Pulsating flame
2. Oil Temperature Gauge
   Oil Pressure Gauge

If OIL PRESSURE is the problem, it will be TOO HIGH.



ON THE DIAGRAM:

CIRCLE THE PART that sends excess oil back to the tank.

PUT CHECKS (✓) ON THE PARTS that clean the oil but could become dirty and clogged.

If the PRESSURE RELIEF VALVE doesn't send enough oil back to the tank, it should be adjusted by service. A clogged line, perhaps at the STRAINERS, will send the oil pressure up.

1. Where does the Pressure Relief Valve send excess oil? _____

2. Which of these can you probably take care of without calling service? _____

3. If you get high oil pressure, what two things should you check? _____

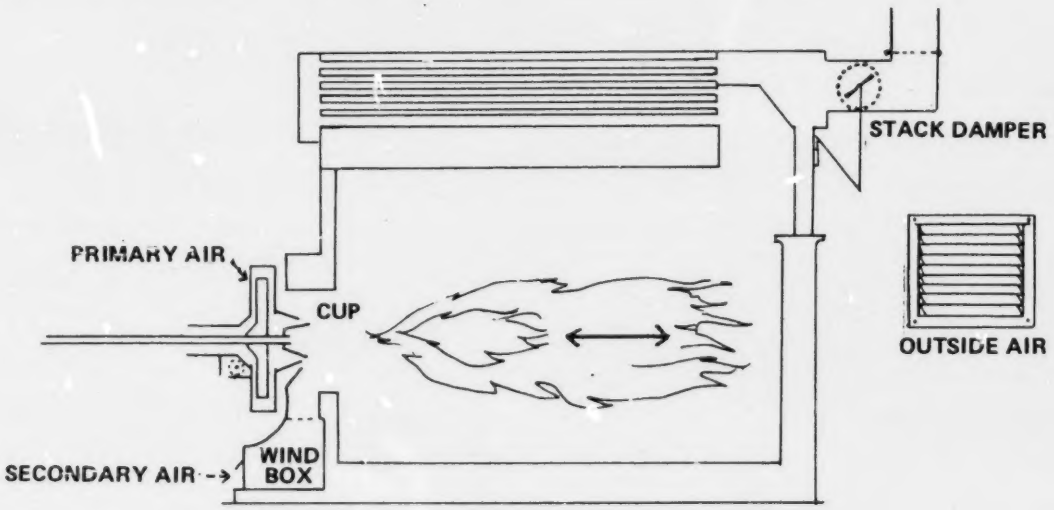
   _____

— Check your answers.

1. to the tank
2. oil strainers
3. pressure relief valve
   oil strainers

After checking the OIL TEMPERATURE and OIL PRESSURE, CHECK for TOO LITTLE AIR before calling service.

CIRCLE PLACES TO CHECK FOR TOO LITTLE AIR ON THE DIAGRAM:



To check for too little air, look at all four air sources above.

1. How is the flame above not a good one? _____

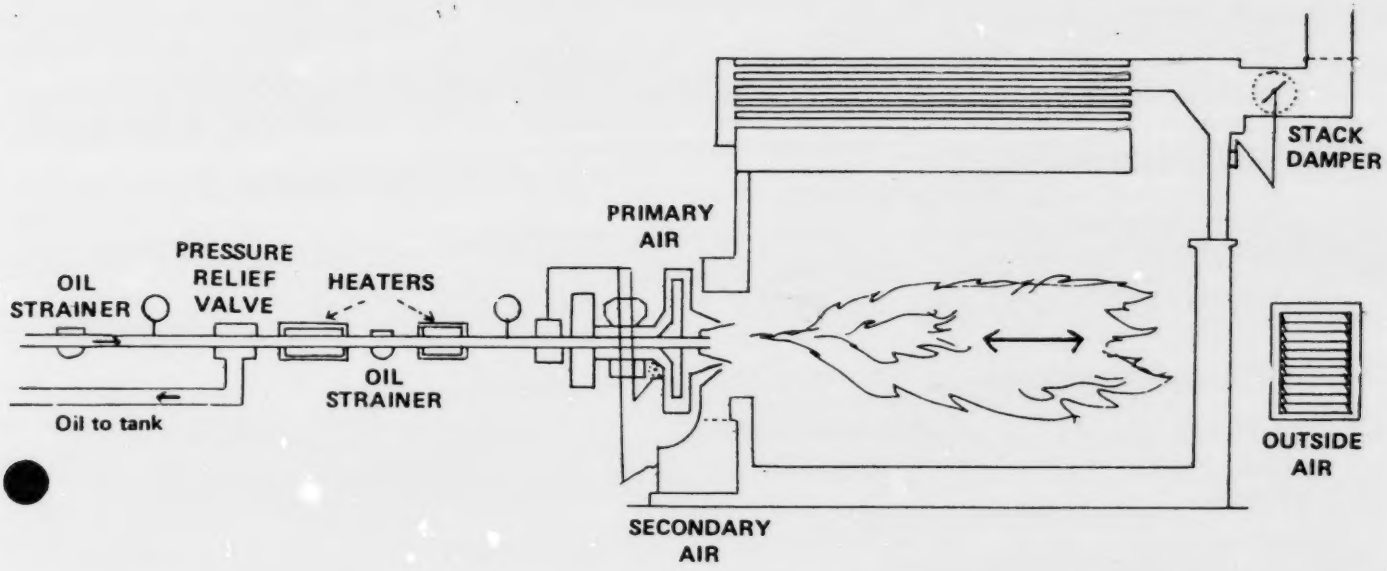
2. What are the areas to check? (CHECK THREE BELOW)

   _____ Oil Temperature
   _____ Cup Condition
   _____ Oil Pressure
   _____ Too Much Air
   _____ Too Little Air

3. How many air sources are there to check if you got a flame like the one above? _____

— Check your answers

1. Pulsating
2. ✓ Oil Temperature
   ___ Cup Condition
   ✓ Oil Pressure
   ___ Too Much Air
   ✓ Too Little Air
3. Four



FOR EACH MAJOR AREA BELOW, WRITE THE PARTS FROM THE DIAGRAM THAT YOU SHOULD CHECK BEFORE CALLING SERVICE.

PULSATING FLAME CHECKS:

1. OIL TEMPERATURE INCORRECT

   Check: _____

2. HIGH OIL PRESSURE

   Check: _____

3. TOO LITTLE AIR

   Check: _____

— Check your answers.

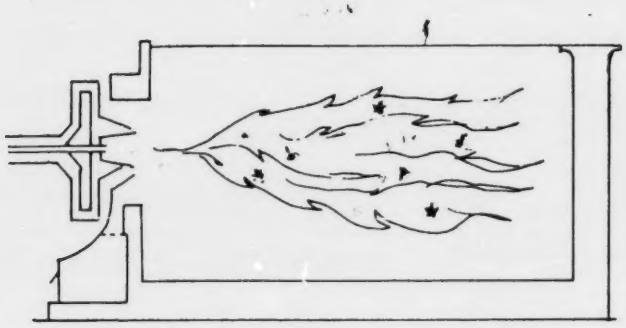
ANSWERS TO PULSATING FLAME CHECKS:

1. OIL TEMPERATURE INCORRECT — Check: Heaters

2. HIGH OIL PRESSURE — Check: Pressure Relief Valve; Oil Strainers

3. TOO LITTLE AIR — Check: Outside Air Supply; Primary Air; Secondary Air; Stack Damper

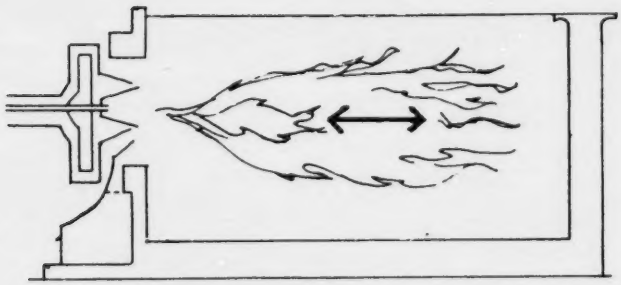
Below are the last two incorrect flames presented. CIRCLE the CORRECT ANSWERS for each.



This flame is:
"SPARKY"
PULSATING

A cause is:
WRONG AMOUNT OF OIL
BITS OF BURNING OIL OR CARBON
UNEVEN OIL FLOW
TOO LITTLE AIR

Troubleshooting Checks:
CUP
OIL TEMPERATURE GAUGE
OIL PRESSURE GAUGE
AIR SUPPLY



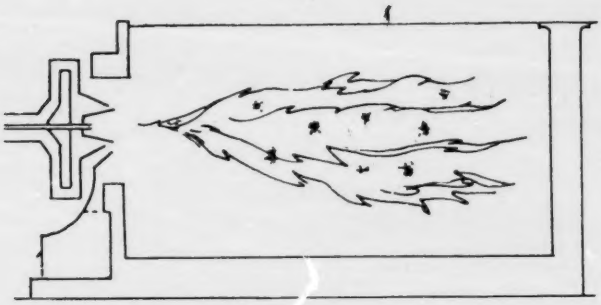
This flame is:
"SPARKY"
PULSATING

Some causes are:
WRONG AMOUNT OF OIL
BITS OF BURNING DIRT OR OIL
UNEVEN OIL FLOW
TOO LITTLE AIR

Troubleshooting Checks:
CUP
OIL TEMPERATURE GAUGE
OIL PRESSURE GAUGE
AIR SUPPLY

— Check your answers.

ANSWERS TO PREVIOUS PAGE:



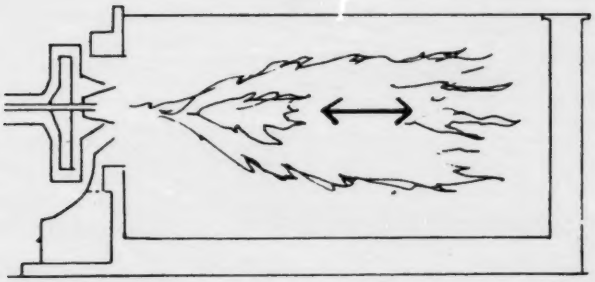
This flame is: "SPARKY"

A cause is:

BITS OF BURNING OIL
OR CARBON

Troubleshooting
Checks:

CUP



This flame is: PULSATING

Some causes are:

WRONG AMOUNT OF OIL

UNEVEN OIL FLOW

TOO LITTLE AIR

Troubleshooting
Checks:

OIL TEMPERATURE GAUGE
OIL PRESSURE GAUGE
AIR SUPPLY

HANDBOOK SUMMARY

TURN TO YOUR BOILER HANDBOOK, PAGE 47.

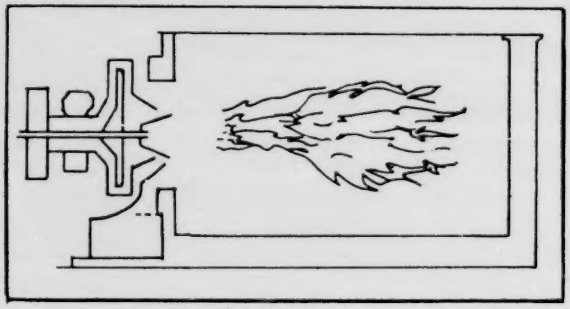
COMPLETE THE LAST TWO INCORRECT FLAME COLUMNS with the information you have just learned. Use page 48 in this book for reference.

This completes some basic flame checks should your smoke alarm go off. If a problem occurs which these pages have not covered or if the problem is not easily solved, call service.

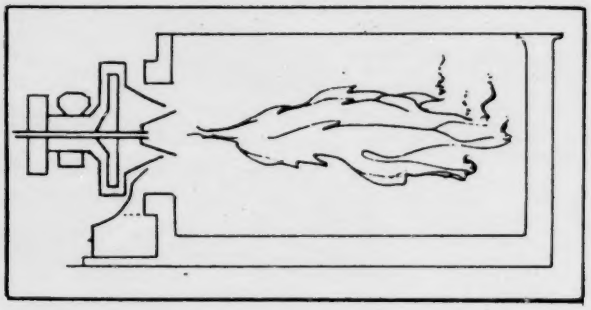
REVIEW QUESTIONS

1. When the smoke alarm goes off, what is the key to troubleshooting after checking the oil temperature? _____

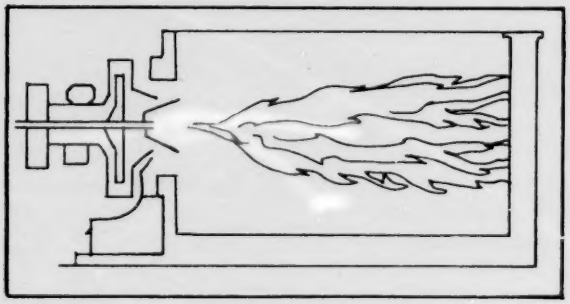
Under each, write what is incorrect about the flames below:



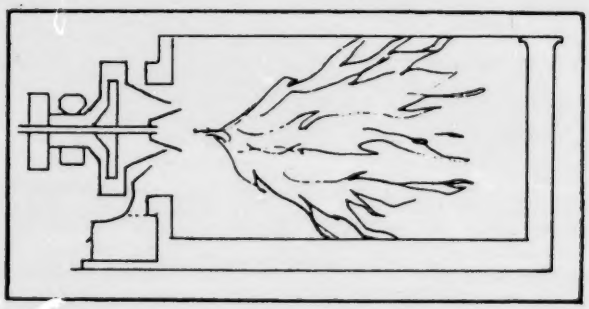
2. _____



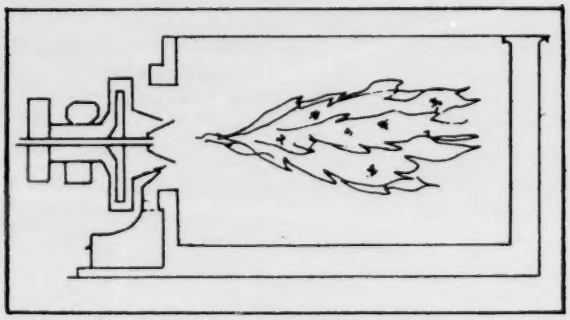
3. _____



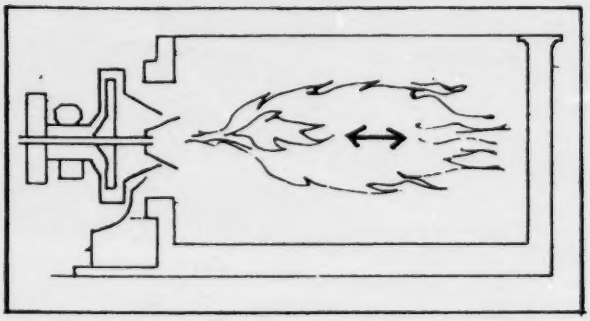
4. _____



5. _____



6. _____



7. _____

8. If the flame is pushed away from the burner, the cause is often too much _____ air. _____

9. Even though you may not make adjustments, what can you do to shutters and linkage to keep them working well? _____

10. What are three main areas (other than outside air) to check when you get a smoky flame and there is not enough air? _____ _____ _____

11. A flame that is too long or too wide could be the result of an incorrect _____ position. _____

12. Is it too much or too little primary air that can cause a flame to be too wide? _____

13. What could be in the oil that may cause "sparks" in the flame? _____

14. What burning supply often needs adjustment to correct a pulsating flame? _____

15. What two gauges should you first check when you get a pulsating flame? _____ _____

16. Assuming normal oil flow, what basic supply usually needs adjustment when you get smoke? _____

17. If oil temperature adjustment and flame reading don't enable you to solve a smoke problem, what should you do? _____

— Check your answers.

ANSWERS TO REVIEW QUESTIONS:

1. the flame
2. flame away from the burner
3. smoky flame
4. too long
5. too wide
6. "sparky" flame
7. pulsating flame
8. primary
9. clean and/or lubricate
10. primary air
    secondary air
    stack damper
11. cup
12. too little
13. oil globs or carbon bits
14. oil
15. oil temperature gauge
    oil pressure gauge
16. air
17. call service